REMARKS

Applicant respectfully thanks the Office for the indication that claims 6 and 17 are merely objected to as depending upon a rejected base claim, but would be allowable if amended to incorporate the limitations of any base and intervening claims. Applicant has amended claims 6 and 17 accordingly.

Applicant also respectfully thanks the Examiner for his courtesy in conducting telephonic interviews with Applicant's undersigned representative on November 12 and 17, 2004. During those interviews, the Examiner offered Applicant helpful suggestions as to arguments and claim amendments that seemed likely to gain allowance of this application.

The claims other than claims 6 and 17, i.e., claims 1, 3-5, 7-15, and 18-36, stand rejected based on prior art grounds.

Applicant respectfully requests favorable reconsideration of the application in view of the following remarks responsive to the Office Action of March 23, 2004.

The Present Invention

The present invention relates to microstrip antennas with improved low angle performance while not diminishing performance closer to the zenith. Particularly, the present invention improves low angle gain of a microstrip antenna primarily by two features of the design. The first feature is a dielectric lens that entirely encapsulates a patch and refracts electromagnetic waves so as to increase the gain at low angles while not substantially affecting gain at higher angles. The second feature is placing the patch on a second ground plane raised above a first ground plane. The raised, second ground plane further enhances the refraction effect, thereby increasing radiation gain at low angles without diminishing gain at the zenith.

The Prior Art Rejections

The Office rejected claims 1, 3-5, 7, 8, 14, 15, 18, and 23-36 under 35 U.S.C. § 103(a) as obvious over Openlander in view of Murphy. The Office further rejected

claims 9-13 and 19-22 under 35 U.S.C. § 103(a) as obvious over Openlander in view of Murphy and further in view of Nichols.

In short, the Office is relying on Openlander as teaching use of a lens to increase low angle gain and is relying on Murphy as teaching placing the first ground plane above and spaced apart from a second ground plane.

As discussed during the aforementioned telephone interviews, Applicant believes that there are two reasons why the proposed combination is improper.

As set forth in MPEP § 2143, a prima facie obviousness rejection must establish three things.

> First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art to modify the reference or to combine the reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations.

As the Examiner himself noted, it appears that the combination destroys the invention of the primary reference, which, of course, inherently leads to the conclusion that there is not a suggestion or motivation in the prior art to make the combination or an expectation of success.

Particularly, the relevant portion of Openlander is found in column 5, line 55 through column 6, line 5, where it discloses:

> As shown in FIG. 4, a plastic package with thick side walls covers and protects the antenna 58. The plastic package, particularly the top cover thereof, 62 may be made of dielectric or the like and has or incorporates prisms 64 at the edges in order to redirect the radiation pattern. In one such embodiment, prisms included in the decorative cover lowered the radiation angle of the PIFA antenna 58 shown in FIGS. 3 and 4 from forty degrees (40º) to twenty degrees (20º) without increasing the height of the overall antenna 58 with its package 60. As disk, or patch, antenna generally have a high radiation angle of sixty degrees (60º) to ninety degrees (90º), the prisms 64 serve to provide a radiation angle in the antenna 58 in a range of approximately seventy degrees (70º) to twenty degrees (20º) from the horizon. A foam layer having adhesive on both sides 66 may serve as a cushion or contact in conjunction with the plastic base 40. The foam layer 66 may serve to seal the antenna 58 within the plastic package 60.

Thus, a key goal of Openlander is to increase low angle gain without increasing the height (profile) of the antenna. The desire to provide a low profile antenna is repeatedly emphasized in Openlander. See, for example, (1) the first sentence of the abstract, (2) the first sentence of the application ("This invention relates to antennae for wireless signal transmission, and more particularly to a low profile cellular antenna design meant for facilitating cellular telephone communications in an inconspicuous manner.", (3) col. 2, lines 45-49, (4) the first line of the summary of the invention, (5) col. 4, line 66 et seq., (6) the preambles of all of the claims.

Turning to Murphy, it teaches a microstrip antenna having a first ground plane disposed above and apart from a second ground plane. However, the reason for doing so in Murphy is totally different than the reason for doing so in the present invention and is irrelevant to the prisms 64 in Openlander. Therefore, there is no motivation in the prior art to make the proposed combination.

Particularly, the purpose of providing the two, spaced-apart ground planes in Murphy is explained in column 3, line 24 through column 4, line 34. Maxwell's equations dictate that the total portion of radiated energy at relatively low radiation angles along the ground plane surface increases as the height of the radiating aperture above the ground plane surface increases. For instance, this is illustrated in Figures 1-5 of Murphy. Specifically, Figures 1, 2, and 3 show the different radiation patterns as a function of the height of the aperture (the small circle in those figures) above the ground plane. Figure 4 of Murphy shows the radiator and the virtual reflected image radiator relative to the ground plane. Figure 5 shows the different radiation patterns expected for the three different positions of the radiating aperture shown in Figures 1, 2 and 3.

Murphy is attempting to change the radiation pattern directly out of the radiating aperture of the microstrip by changing the vertical distance between the radiating aperture and the reflected image of the radiating aperture relative to the ground plane. As indicated in Murphy, this is accomplished by distances of ¼ or ½ of a wavelength. These are huge distances relative to the distances at issue in the present invention and Openlander.

In the present invention, the microstrip and first ground plane are raised above the second ground plane in order to make it possible to practically form a lens that will have the correct optical properties close to the radiating microstrip. More particularly, if the radiating microstrip is positioned directly on a large ground plane that extends transversely far beyond the microstrip, it would be very difficult to manufacture a lens with appropriate optical properties so close to the large ground plane. However, by placing the microstrip on a ground plane with transverse dimensions that are only slightly larger than the microstrip and then supporting that assembly above the second, larger ground plane via slanted support portions which provide open space immediately transversely adjacent the microstrip, it is much easier to fabricate the lens. See, for instance, page 5, line 18 through page 6, line 6 of the present specification.

Thus, there would be no motivation to make the proposed combination for several reasons. First, Openlander strongly emphasizes that his antenna must have a low profile. Murphy, on the other hand, spaces his two ground planes apart by at least ¼ of a wavelength. This would produce an antenna that was anything but low profile. Hence, Openlander essentially teaches away from the proposed combination.

Secondly, as just noted, the theory of Murphy is that the radiator itself will radiate at low angles, in which case, the prism of Openlander likely will have an undesirable effect, rather than a desirable effect. Particularly, since the radiator of Murphy will already be producing significant radiation at low angles and poor radiation at high angles, the prisms 64 of Openlander will change the radiation pattern out of Murphy's radiator. It is difficult to know how it would change the radiation pattern, but it quite possibly will make it too narrow or possibly reverse the low angle pattern achieved by Murphy. Thus, at best, the results of the proposed combination are unpredictable (in which case, there would be no "reasonable expectation of success") and, at worst, the proposed combination has a deleterious effect opposite to the desired effect of either reference.

Thirdly and perhaps most significantly, as discussed in the specification of the present application, applicant does not want to reduce gain at zenith. Applicant's

invention is particularly adapted for use with satellite radio such as the XM™ and Sirius™ satellite radio systems, in which satellites are positioned at a fairly low angle to the horizon in order to cover a large geographic area with a small number of satellites (about 2 to 4). At least one of these satellite radio systems also uses a satellite close to the zenith. Accordingly, it is important to have excellent low angle gain while not substantially diminishing gain at zenith. Hence, Applicant's invention achieves increased gain at low angles while not significantly decreasing gain at zenith.

Murphy's Figure 5 clearly illustrates that Murphy's concept of radiating directly out of the radiator at low angles is at the sacrifice of gain near zenith. Specifically, as the height of the upper ground plane above the lower ground plane increases, the gain at zenith decreases while the low angle gain increases. This is contrary to Applicant's goals and thus the proposed combination does not achieve the goals of the present invention.

Applicant has amended the independent claims, claim 1 and 15, to expressly recite that the gain at zenith is not significantly reduced. Support for these amendments is found in Figures 5A, 5B, 6A, and 6B as well as page 1, lines 10-12, page 3, lines 6-14, page 5, lines 18-21, and page 10, lines 17-19.

This is contrary to the teachings of Murphy. This factor, in combination with the fact that we do not even know what the radiation pattern of Murphy's raised radiator placed in front of Openlander's prism would be naturally leads to the conclusion that the proposed combination of Openlander and Murphy neither is suggested in the prior art nor does it result in the present invention as claimed in any event.

Hence, for the foregoing reasons it is not obvious to make any combination of Openlander and Murphy that results in the present invention as claimed in claims 1 and 15. Since all other claims depend from one of these claims, they too are patentable.

In view of the foregoing amendments and remarks, this application is now in condition for allowance. Applicant respectfully requests the Examiner to issue a

Notice of Allowance at the earliest possible date. The Examiner is invited to contact Applicant's undersigned counsel by telephone call in order to further the prosecution of this case in any way.

Respectfully submitted,

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